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(54) AUTOMATIC TRANSMITTER-FINDING AND TUNING MEANS FOR RECEIVING EQUIPMENT IN THE COMMUNICATION ART

(71) We, TELEFUNKEN PATENTVERWERTUNGSGELLSCHAFT m.b.H., of Elisabethenstrasse 3, Ulm/Donau, West Germany, a German Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to an automatic transmitter-finding and tuning means for receiving equipment in the communication art, particularly for radio and/or television equipment, wherein the tuning circuits can be tuned electronically, particularly by means of voltage-responsive capacitors, the automatic transmitter finding is effected by applying a periodically recurring or repeatable, rising tuning voltage to the tuning elements, and the transmitter finding is interrupted by the voltage derived from a discriminator in the receiver when the incoming transmitter is picked up, and fine tuning to this transmitter may be effected.

Such an automatic circuit is particularly suitable for remote tuning because all the transmitters in a frequency range can be selected one after the other by simply pressing pushbuttons. A disadvantage of this known circuit, however, is that the whole tuning range is always covered and therefore no programming of transmitters is possible.

It is therefore one aim of the invention to render the programming of one or more transmitters possible. It is intended that the operation of the receiving equipment should be simplified by this means since the possibility is afforded of direct transmitter selection and of transmitter selection by finding.

According to the invention there is provided an automatic tuning arrangement in which tuning is performed electronically and in which at least one adjustable voltage divider connected across a fixed voltage source is provided, together with a switch to bring the voltage obtained from the voltage divider into connection with the tuning elements either as an alternative to the automatic tuning voltage or in addition thereto.

In a preferred form of automatic tuning arrangement according to the invention, particularly for radio and/or television sets, automatic transmitter finding is effected by applying a periodically recurring or repeatable, rising tuning voltage to the tuning elements, and the transmitter finding is interrupted by the voltage derived from a discriminator of the receiver when the incoming transmitter is picked up, and fine tuning to this transmitter may be effected, wherein the fixed voltage is supplied through the station buttons to a saw-tooth generator in each case wherein the saw-tooth begins at a voltage value which is below the voltage which is associated with the particular transmitter frequency required and wherein the electronic switch discharges the charging capacitor of the saw-tooth generator at a value which is above the tuning voltage associated with the transmitter frequency.

By this means, it is easily possible to set any desired transmitter with a station button, that is to say to programme it, and, for example by pressing a finding button, to switch off the fixed voltage switched on thereby and to switch on the automatic finding and tuning means and vice versa.

Further advantageous details and further developments of the invention are described below with reference to the examples of embodiments illustrated in the accompanying drawings, in which:—

Figure 1 shows a circuit according to the invention of the commonest kind;

Figures 2 and 3 show the associated diagrams for the tuning voltage;

Figure 4 shows one having a saw-tooth generator wherein the discharge process is controlled and swerves to form the tuning voltage;

Figures 5 and 6 show the saw-tooth voltages which can be established by means of the circuit shown in Figure 4;

Figure 7 shows a saw-tooth generator using a thyristor;

Figures 8 and 9 show the associated saw-tooth voltage diagrams which can be established;

Figure 10 shows a basic circuit diagram of the circuit arrangement according to the invention with a frequency-range switch and

Figure 11 shows a possibility for the remote switching on of preset transmitters as well as the frequency-range switching over and automatic transmitter selection during finding and

Figures 12 and 13 show a saw-tooth generator according to the invention.

In Figure 1, a tuning unit for a receiving set, for example for a television set, is designated diagrammatically at 1, two oscillatory circuits 2 being provided therein which can be tuned by means of capacitance-varying diodes 3. The oscillatory circuits 2 may, for example, form a band-pass filter, tuning over the range of which is possible by means of the capacitance-varying diodes 3. An oscillator, not illustrated, which can likewise be tuned by means of a capacitance diode, forms with the reception frequency an intermediate frequency which can be supplied to the receiver.

A tuning voltage U_A is supplied to the capacitance diodes 3 through a series resistor 4. The tuning voltage may be formed by voltage dividers 5, the resistance of which is connected between earth and the diode voltage $+U_D$. One of the potentiometers 5 can be selected at a time by a switch 6. Furthermore, an automatic circuit 7 is provided which may contain a saw-tooth generator for example, and the saw-tooth voltage can be adjusted to a constant value by means of a regulator 8. The automatic circuit is fed from a discriminator at the point 9.

According to the invention, a changeover switch 10 is provided which is coupled to an "automatic" switch 11. The tuning voltage U_A can be taken off from the automatic circuit 7 at a charging capacitor 12.

The mode of operation of the circuit is as follows:

Let it be assumed that the switches 10 and 11 are in the position shown. In this case, the voltage dividers 5 can be switched on, the one shown on the extreme right supplying the tuning voltage U_A to the capacitance-varying diodes 3. A transmitter can be set and stored by adjusting the slide of this voltage divider 5. The voltage dividers 5 may be combined with a pressure or push-button switch on the actuation of which the particular voltage divider is connected into the circuit and the tuning voltage is connected up to the capacitance diode 3. A plurality of transmitters can therefore be sought and programmed according to the number of voltage dividers 5 present.

In the diagram shown in Figure 2, the voltage values designated by S1, S2 and S3 correspond to transmitters which can be set when this voltage is set by applying the same to the capacitance-varying diode 3. Let it be assumed that the three voltage dividers shown in Figure 1 are set to these three transmitters. One of these transmitters at a time can therefore be connected in by changing over the switch 6. When the switches 10 and 11 are switched over to automatic transmitter finding, the saw-tooth voltage which can be taken off at the charging capacitor 12 is run through from the bottom upwards and when the transmitter S1 is picked up, the discriminator voltage causes an automatic fine tuning to this transmitter. The fine tuning can be interrupted by short-circuiting a finder button 13 associated with the regulator 8 so that the charging capacitor 12 is further charged until the transmitter S2 is picked up. Precise adjustment of this transmitter is then effected by means of the discriminator. The voltage diagram described here is shown in Figure 3. As can be seen, not only can any desired transmitter and a frequency range be stored by means of this circuit arrangement and switched on at any time, for example by pressing a button, but also any desired transmitter can be selected in a succession by switching over to finding.

A further example of an embodiment of the invention is illustrated in Figure 4. In this case, the process of charging the charging capacitor 12 is not interrupted but it is always charged to the full value and the discharge process is controlled. The charging capacitor 12 is connected to the operating U_B through a charging resistor 14. The junction point 15 between the two is connected, through a resistor 16, to the base of a transistor 17 connected with its collector-to-emitter path between U_B and earth. A zener diode 18, the thermal voltage of which corresponds to the maximum tuning voltage U_A may appropriately be connected in the emitter path. The collector of the transistor 17 is connected to the input of a multivibrator 19, the pulse duration of which can be adjusted by means of an adjusting resistor 20 and one or more variable resistors 21 and the capacitors 22 and 23 respectively connected thereto. The input to the multivibrator 19 is effected through a capacitor 24 and the diode 25 which is connected in such a manner that it only allows negative voltages through to the base of the one transistor 26. The collector of the other transistor 27 is connected through a diode 28 to the charging capacitor and the base of the transistor 17.

The regulator 8 consists of a transistor 29, the base of which is connected through a capacitor 30 to the tuning voltage U_A and the base of which is further connected to earth through a diode 31. The collector of the transistor 29 is connected to the base of a further transistor 32, the collector of which is in turn connected to the emitter of a regulating transistor 33. The emitter of the regulating transistor 33 is connected to earth through a setting regulator 34. The setting regulator 34 swerves to set the response value of the regulating transistor 33, the collector of which is connected to the tuning voltage U_A. The base of the regulating transistor is connected, through a resistor 35, to a discriminator which is not shown in the circuit.

The base and the emitter of the regulating transistor 33 can be bridged by means of the finder button 13. The finder button 13 is preferably coupled to a switch 36 by means of which the resistors 21 can be switched on or off, in which case the coupling must be effected in such a manner that on actuation of the finder button 13 the switch 36 is opened and after the opening of the finder button 13, the switch 36 remains open.

The mode of operation of this circuit is as follows:

As a result of applying the voltages U_B, U_D and the discriminator voltage, the charging capacitor 12 is first charged through the resistor 14. With switch 36 open, the pulse duration is so great that the multi-vibrator 19 remains open over the whole duration of the cycle of the saw-tooth. By this means, if no transmitter is in action, the charging capacitor 12 is charged substantially to the voltage of the zener diode 18. At the moment when this voltage is reached, the transistor 17 is conductive. By this means, a negative pulse reaches the base of the transistor 26 through the capacitor 24 and the diode 25 so that the transistor 26 is changed over from the transmission to the cut-off range. As a result, the base of the transistor 27 is raised in potential and this is conductive. Now the charging capacitor 12 can be discharged through the transistor 27 until the transistor 27 is again cut off in accordance with the setting of the setting regulator 20 and the capacitance value of the capacitor 22. Now the charging capacitor 12 can again be charged to the full voltage U_A.

If there is a transmitter in action in the range through which tuning is effected, for example the transmitters S1, S2 and S3 described with reference to the previous figures, then during the charging of the charging capacitor 12, a voltage is reached at which the tuning to these transmitters is substantially obtained. When a positive voltage appears at the discriminator and hence also at the base of the transistor 33, this becomes conducting. Since the transistor 29 changes over into the off state at the same time and as a result, the transistor 32 changes into the on state, the setting regulator 34 is short-circuited so that a very low voltage is necessary at the base of the regulating transistor 33 in order to control the transistor 33. As a result, fine tuning of the transmitter picked up is substantially obtained.

In order to be able to switch over to a following transmitter, it is only necessary for the finder button 13 to be actuated briefly. Since the response value can be adjusted by means of the setting regulator 34, a transmitter can be selected which has a greater field strength so that only this is selected while transmitters having lower field strength are ignored. In this operating state, therefore, tuning is always effected over the whole frequency range and when a transmitter is picked up having appropriately high field strength, which can be set by means of the setting regulator 34, fine tuning is effected to this.

If the switch 36 is now closed, the setting regulator 21 and the capacitor 23 are connected into the circuit of the multivibrator 19. The pulse duration of the multivibrator 19 can be regulated within wide limits by this means in accordance with the setting of the setting regulator 21.

This ensures that with a short pulse duration, the charging capacitor 12 is only slightly discharged and with a longer pulse duration it is discharged to a greater extent. Accordingly, a curve such as is illustrated in Figure 5 is obtained. For example, if the pulse duration is selected in such a manner that the discharge is effected up to the point P1, then the two transmitters S2 and S3 can be set automatically on running through the saw-tooth, that is to say the transmitter S3 when the transmitter S2 has faded out or through brief actuation of the finder key 13.

If the setting regulator 21 is set in such a manner that the charging capacitor 12 can only discharge up to the point P2, then only the transmitter S3 still remains in the further range of the saw-tooth so that when the switch 36 is switched on only the transmitter S3 is received and finally tuned in. As can be seen from this, by suitable selection of the points P1, P2 . . . , the transmitter following immediately thereon can be programmed and in some cases, in the absence of this transmitter, tuning is effected to the followed immediately thereon can be prother programming may be achieved in some circumstances in that, as a result of appropriate setting of the setting regulator 34, the first transmitter can be programmed if this has a higher field strength than the following ones.

A circuit functioning in a similar manner is obtained if a switch 37 is connected into

the connecting line between the zener diode 18 and the charging capacitor 12 instead of the switch 36, the setting regulator 21 and the capacitor 23, as a result of which the charging capacitor 12 and the parts of the multivibrator 19 connected to earth can be disconnected from earth. Connected to this disconnected portion is the slider 38 of the potentiometer 39, the resistance path of which is connected on the one hand to earth and on the other hand on an operating voltage. When the switch 37 is closed, the automatic finding is effected by means of the regulating transistor 33 and the finder button 13 as described above. When the switch 37 is open, a basic d.c. voltage is connected up to the charging capacitor 12 and the multivibrator 19 so that a circuit is obtained which delivers a saw-tooth form as illustrated in Figure 6. In this case, the saw-tooth is raised by the basic d.c. voltage U_G. The effect is therefore the same as when the resistor(s) 21 and the capacitor 23 are present.

A further advantageous embodiment of the invention is then illustrated in Figure 7. In this case, the multivibrator 19 is replaced by a circuit having a thyristor 41. This is connected in parallel, through a current-limiting resistor 42, to the tuning voltage U_A and hence to the charging capacitor 12. The control electrode of the thyristor 41 is connected to a voltage divider which consists of a setting regulator 43 and a fixed resistor 44. A resistor 45 can be connected in parallel with the setting regulator 43 through a switch 46 and a capacitor 47 can be connected in parallel with the charging capacitor 12 through a switch 48. The lower connections of the charging capacitor 12, the fixed resistor 44, of the thyristor 41 and of the capacitor 47 can be connected, through a changeover switch 49, either to earth or to a selector switch 50. Sliders 38 of potentiometers 39 are connected to the individual contacts 51 of the selector switch 50. The lower connections can thus be set to a basic d.c. voltage as in the example shown in Figure 4.

The mode of operation of this circuit arrangement is as follows:

The function of the regulator 8 is the same as described with reference to Figure 4. When the voltages are applied, the charging capacitor is first charged, through the series resistor 14, up to a value which can be determined by means of the setting regulator 43. In the first instance, let it be assumed that this is set in such a manner that the maximum tuning voltage U_A is obtained. If there is no transmitter present, a saw-tooth voltage is obtained such as is illustrated by the first saw-tooth in Figure 8. The lower this resistor is set, the lower is the voltage to which the charging capacitor 12 can be charged because then the thyristor is turned on already at a lower voltage and the charging capacitor 12 is discharged through the thyristor 41 and the current-limiting resistor 42. The charging resistor 14 should be selected in such a manner that the current is below the holding current of the thyristor 41 as a result of which this changes over into the non-conducting state. If there is a transmitter on the branch of the saw-tooth, this is tuned in and on brief actuation of the finder button 13, the next one can be set and tuned in. As the amplitude of the saw-tooth becomes less, the frequency of the saw-tooth curve becomes higher. This can be avoided by connecting up the capacitor 47 to the charging capacitor 12 through the switch 40. By this means, an elongated saw-tooth is obtained as in the case of the last two saw-teeth in Figure 8.

With this arrangement, when the changeover switch 49 is switched over to so-called programming, that is to say to the potentiometer 39, the switches 46 and 48 are actuated simultaneously. As a result, through the resistor 45 being connected in parallel with the setting regulator 43, the saw-tooth curve is brought to such a low value that at most one transmitter lies within this amplitude and this can be tuned in while the frequency of the saw-tooth curve is reduced by the capacitor 47 as explained above. Since in this example the saw-tooth curve always begins from zero, a basic d.c. voltage can be associated with this through the potentiometer 39 as explained with reference to Figure 9. For example, a potentiometer 39 is adjusted in such a manner that the basic d.c. voltage has such a value that the voltage necessary for the precise tuning to the transmitter S1 lies within the rise of the saw-tooth as illustrated by the point P3 with reference to Figure 9.

Such a circuit is preferably provided that, on actuation of the finder button 13, the switches 46, 48 and 49 are brought into the position shown in Figure 7, that is to say are switched to finding. This can be brought about by a coupling of mechanical or electronic or electro-mechanical nature.

As can be seen, a definite programming to individual transmitters is possible by means of the potentiometer 39 with this last circuit, in that the saw-tooth generator is connected in such a manner that the amplitude of the saw-tooth only has that order of magnitude in which there is a transmitter, that is to say at most one channel width can be covered thereby; this voltage may be 1.5 v for example. On the other hand, the transmitters can be selected in succession at any time by finding, simply by actuation of the finder button 13.

Without departing from the invention, the operating knob for the setting regulator 43

may be taken out in such a manner that not only can the maximum value of the saw-tooth be determined from the outside by means of the setting regulator 43 but also the beginning of the saw-tooth curve by setting of the potentiometer 39. It is thus possible to determine from the outside from which voltage up to which voltage the saw-tooth should run, so that the possibility is afforded, for example, of being able to situate one, two or more transmitters on one branch of the saw-tooth.

According to an advantageous construction of the invention, the automatic transmitter-finding and tuning means may also be used for a plurality of frequency ranges as a result of the fact that, as illustrated in Figure 10, the tuning unit 1 has a frequency-range switch 51 associated with it which can be actuated mechanically by means of a rotary switch or by means of a push-button circuit so that all the television frequency ranges UHF, VHF band I and VHF band III can be switched on by means of the tuning diode 3 in known manner as is the case with the so-called all-band selectors. Electrical switching-over may, however, be provided instead of mechanical switching over, for example by providing an electrical stepping device 52 in which case whenever the push-button 53 thereof is pressed, there is a changeover from one range to the next, which may be effected, for example, by means of a ratchet mechanism.

It is also possible, however, to construct the stepping switches 52 in the form of electronic switches, for example by means of a multivibrator having a plurality of stable switching states. This may be controlled by the flyback pulse of the saw-tooth so that a pulse is applied thereto by the steep edge on every run through of the saw-tooth voltage. Each stage thereof is connected as a switch between the capacitance-varying diodes 3 and the elements determining the oscillatory circuit so that on switching through, the transistor which is switched through connects up a frequency-determining element, which is associated with one frequency range, to the capacitance-varying diodes. By this means, the television ranges I, III, UHF for example are progressively selected and, within these, a setting to the transmitters present is possible.

In Figure 10, push-buttons 54 are associated with the potentiometers 39. When one of these is pressed, a switch 55 is closed which can connect the sliders 38 of the potentiometer 39 to the saw-tooth generator S, as a result of which the saw-tooth is acted upon by a basic d.c. voltage. These push-buttons 54 are preferably designed in such a manner that the frequency range switch 51 is actuated mechanically thereby so that one frequency range is permanently associated with each push-button 54. The arrangement is preferably selected in such a manner, however, that one frequency range can be preselected by turning the push-button 54 for example and can be switched on by turning it. Thus any desired frequency range can be preselected by each push-button 54 and be switched on when it is pressed, while and desired transmitter can be permanently programmed in each frequency range. The switching over from programming to finding may be effected, for example, by pressing the finder button 13 after which there is a complete run through the saw-tooth. This is preferably effected by means of a push-button 56 which is associated with the finder button 13.

According to an advantageous further development of the invention illustrated in Figure 11, the switches 55 can each be selected by means of an electromagnet 57 so that the individual potentiometers 39 associated with the push-buttons 54 can be switched on by means of buttons 59 from a remote control section 58. The push-button 56 for the actuation of the finder button 13 and the button 53 for the actuation of the stepping switch 52 or of the multistable multivibrator for the frequency-range switching is also provided at the remote control section 58. The switching unit with the push-buttons 54 is preferably directly coupled to the tuning unit 1 for the direct frequency range switching by means of the push-buttons 54 so that when the push-buttons 54 are pressed, the frequency range switch 51 can be actuated mechanically.

In order to be able to indicate the particular frequency range which is switched on, particularly for transmitter finding, a contact for an indicator lamp can be actuated by the frequency range switch or by the member actuating this, for example the stepping switch 52 or the above-mentioned multistable multivibrator, one indicator lamp being associated with each frequency range. These lamps may be provided in the receiving set, in the push-button arrangement for the push-buttons 54 and/or in the remote control section 58. Furthermore, the potentiometers 39 may be used directly or indirectly through the push-buttons 54 or a separate central tuning button for the channel or transmitter indication as is known per se in television sets.

In order to achieve a substantially constant frequency deviation with various values of the basic d.c. voltage U_G notwithstanding the use of capacitance-varying diodes 3 which normally have a non-linear dependence of the capacitance on the applied inverse voltage, circuit means are preferably provided whereby the saw-tooth amplitude is increased as the basic d.c. voltage rises.

The electronic switch such as is used in

the invention as shown in Figure 7 is illustrated in Figures 12 to 15. By means of this, not only can the amplitude of the saw-tooth voltage be adjusted from a few volts up to the breakdown voltage but also the beginning of the charging can be determined by means of a pulse in a simple manner.

It is true that circuits are already known with controllable four-layer diodes, so-called thyristors, wherein the breakdown voltage is reduced by applying a positive voltage to the control electrode. The quenching, that is to say the turning off, is effected by the fact that an alternating voltage is applied to the thyristor and therefore this changes over into the off state on passing through zero or a separate charging capacitor is provided which is charged to the voltage appearing at the thyristor and is connected up to the thyristor with reversed polarity by means of a switch. This capacitor must, however, be so large that when it is connected up the current is below the holding current of the thyristor. These arrangements are unnecessary with the subject of the invention.

In Figure 12, a capacitor is designated at 60 which is connected on the one hand to earth and on the other hand, through a resistor 61, to the positive pole of a voltage source of up to 1000 V for example. The output voltage U_A can be taken off at the connecting point 62 as a saw-tooth curve.

A thyristor 63 is connected by its collector-to-emitter path C—E in parallel to the capacitor 60. The collector C-base B path, that is to say the collector-to-control electrode path has a setting regulator 64 in parallel therewith, the slider 65 of which is connected to the control electrode B. Also connected to the latter is a capacitor 66 through which a negative voltage pulse 67 can be applied, for example by means of a trigger circuit.

The mode of operation of the switching circuit according to the invention is as follows:

If voltage is applied to the switching circuit, then the thyristor 63 is turned off in the first instance, that is to say its input resistance is very high. As a result, the capacitor 60 is charged through the resistor 61. The voltage up to which the capacitor 60 can be charged can be adjusted by means of the setting regulator 64, that is to say the amplitude is adjustable by means of this. When this voltage is reached, then the voltage supplied to the control electrode B through the slider 65 of the setting regulator 64 is so high that a base current flows of such a magnitude that the thyristor 63 "fires" at the voltage applied, that is to say has a very low resistance in the forward direction. As a result, the capacitor 60 is discharged across the thyristor 63. Since the voltage appearing at the thyristor 63 does not drop entirely to zero, nor is it reversed, its switching state is retained. This corresponds to the abscissae in the diagram shown above the output.

If a negative voltage pulse 67 is now applied to the control electrode B through the capacitor 66, the thyristor 63 is momentarily brought into the off state and the capacitor 60 is charged. This process begins at the arrows in the diagram in each case. The voltage U_A therefore rises in accordance with the time constant of the resistor 61 and the capacitor 60 in accordance with an e-function until the voltage set by means of the setting regulator 64 is reached, that is to say the switching point at which the thyristor changes over into the switching state. As a result, the voltage U_A collapses. Thus a saw-tooth curve is obtained having a cycle duration 68 which depends on the pulse train of the pulses 67. When the pulses are derived from a trigger circuit, the cycle duration 68 is determined by this. The pulses may, however, be applied in any desired manner.

Figure 13 shows a further advantageous trigger circuit. With the simplest elements and uncomplicated construction, this forms a saw-tooth generator, the amplitude and frequency of which can be easily varied and which, in addition, can be operated in a simple manner so as to be self-oscillating or externally controlled. According to the invention, this is achieved in that in addition to the circuit illustrated in Figure 12, an inductance 69, which may appropriately be bridged by means of a switch 70, is connected into the circuit between the junction point 62 and the collector C. The setting regulator 64 is connected to the junction point 62.

The mode of operation of this circuit, with the switch 11 open is as follows:

When the operating voltage is applied, the thyristor 63 is at first turned off so that the capacitor 60 is charged through the resistor 61 and the output voltage U_A rises in accordance with Figure 14. When the switching voltage set by means of the setting regulator 64 is reached, the thyristor 63 changes over into the on state, the capacitor 63 is discharged across the inductance 69 and the thyristor 63 and the voltage U_A collapses. A negative voltage which allows the thyristor to change over into the off state is presumably produced briefly as a result of the self-induction through the inductance 69 in this case so that the process begins afresh. Accordingly, a saw-tooth voltage having great linearity in the rising branch is obtained and can easily be varied by varying the capacitance of the capacitor 60, the resistnce of the resistor 61 and by means of the setting regulator 64. In this circuit arrange-

ment with the inductance 69, there is freedom in the selection of the resistance of the resistor 61 and in the capacitance of the capacitor 60.

By changing over the switch 70 into its closed position, a circuit is obtained as shown in Figure 12 with the associated output voltage U_A as shown in Figure 15. The pulses 67, 71 are preferably derived from a trigger circuit.

According to a further advantageous development of the invention, a self-oscillating trigger stage can be obtained without using an inductance 69 if the resistor 61 is selected so large that the current is always below the holding current of the thyristor 63 after the discharge of the capacitor 60. Switching over to external control is then only possible by reducing the resistance 61 in which case however, the cycle duration 68 changes. In order to avoid such a change, the capacitor 60 would have to be enlarged accordingly. This is shown in broken lines in Figure 13, a capacitor 60^1 being connected in parallel with the capacitor 60 and a resistor 61^1 in parallel with the resistor 61.

WHAT WE CLAIM IS:—

1. An automatic tuning arrangement in which tuning is performed electronically and in which at least one adjustable voltage divider connected across a fixed voltage source is provided together with a switch to bring the voltage obtained from the voltage divider into connection with the tuning elements either as an alternative to the automatic tuning voltage or in addition thereto.

2. An automatic tuning arrangement as claimed in Claim 1, particularly for radio and/or television sets, wherein automatic transmitter finding is effected by applying a periodically or repeatable, rising tuning voltage to the tuning elements, and the transmitter finding is interrupted by the voltage derived from a discriminator of the receiver when the incoming transmitter is picked up, and fine tuning to this transmitter may be effected, wherein the fixed voltage is supplied through the station buttons to a saw-tooth generator in each case, wherein the saw-tooth begins at a voltage value which is below the voltage which is associated with the particular transmitter frequency required and wherein the electronic switch discharges the charging capacitor of the saw-tooth generator, at a value which is above the tuning voltage associated with the transmitter frequency.

3. A circuit arrangement as claimed in Claim 2, wherein the fixed voltage can be switched on through a voltage divider or dividers by means of a push-button and/or rotary switch and the automatic circuit can be switched on by means of a further switch acting as a changeover switch, and the one releases the other or cancels its switching function, the changeover switch being coupled to at least one push-button and/or rotary switch in such a manner that the tuning voltage reaching the tuning elements is supplied by the voltage divider on actuation of a coupled push-button and/or rotary switch and by the automatic circuit on actuation of the changeover switch.

4. A circuit arrangement as claimed in Claim 3, wherein one frequency range (for example one of the television ranges VHF band I, VHF band III, UHF) is associated with each push-button and/or rotary switch.

5. A circuit arrangement as claimed in Claim 3 or 4, wherein the automatic circuit comprises a saw-tooth generator which contains circuit means whereby the initial value of the saw-tooth is adjustable in height.

6. A circuit arrangement as claimed in any one of Claims 2 to 5, wherein the saw-tooth voltage is taken off from a charging capacitor and the height of the initial value of saw-tooth is adjustable by different discharging of the charging capacitor.

7. A circuit arrangement as claimed in Claim 6, wherein the saw-tooth is produced by means of a multivibrator and the initial value can be selected by the adjustable pulse duration thereof.

8. A circuit arrangement as claimed in any one of Claims 2 to 7, wherein both the maximum value and also the initial value of the voltage of the saw-tooth generator are adjustable.

9. A circuit arrangement as claimed in any one of Claims 2 to 8, wherein the amplitude of the saw-tooth or its maximum value is selected so low or is adjustable so that there is only one transmitter in the range through which tuning is possible and that such an adjustable basic d.c. voltage can be connected up to this saw-tooth that the whole tuning range can be covered thereby.

10. A circuit arrangement as claimed in any one of Claims 2 to 9, wherein the saw-tooth generator is formed by a charging capacitor which can be charged through a series resistor and a thyristor is connected in parallel with this charging capacitor and the control electrode of which is controlled, depending on the charging voltage of the charging capacitor and wherein the series resistor may be selected so large that the current does not drop below the holding current of the thyristor.

11. A circuit arrangement as claimed in Claim 10, wherein when a basic d.c. voltage is connected up through potentiometers, a resistor which is so dimensioned that the saw-tooth amplitude is only such that only one transmitter is included therein, is connected in between the tuning voltage and the control electrode of the thyristor and wherein at the same time, an additional capacitor

by means of which the frequency of the saw-tooth curve is reduced is connected up in parallel to the thyristor.

12. A circuit arrangement as claimed in any one of Claims 2 to 11, wherein when the automatic means are switched on, the saw-tooth voltage is traversed from the minimum value up to the maximum value and of switching over to programme storage the tuning voltage is composed of a saw-tooth voltage of lower amplitude and an adjustable basic d.c. voltage.

13. A circuit arrangement as claimed in Claim 12, wherein when the switch provided for the programme storage is switched on, a band switch can be actuated, preferably being preselected and operated thereby, and during automatic finding, it can be actuated by means of a separate switch.

14. A circuit arrangement as claimed in Claim 13, wherein the separate switch is a bistable or multistable multivibrator and the oscillatory-circuit elements determining the frequency range in each case are each connected into one circuit of one of the switching transistors of the multivibrator.

15. A circuit arrangement as claimed in Claim 13 or 14, wherein during automatic finding, the frequency ranges (VHF band I, VHF band III, UHF) are traversed periodically in succession.

16. A circuit arrangement as claimed in any one of Claims 13 to 15, wherein the network causing the switching over of the frequency range for switching over from one frequency range to the other is controlled by the flyback pulse of the saw-tooth.

17. An automatic tuning arrangement substantially as hereinbefore described with reference to the accompanying drawings.

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5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1

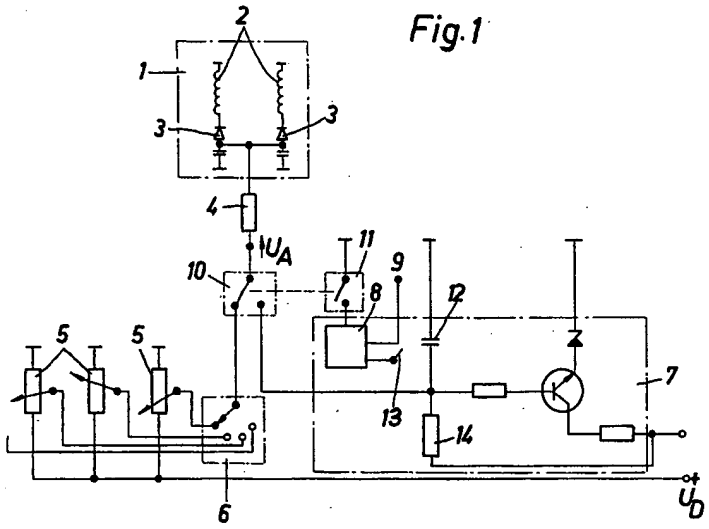


Fig.2 Fig.3

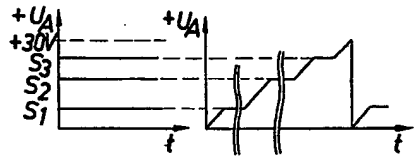
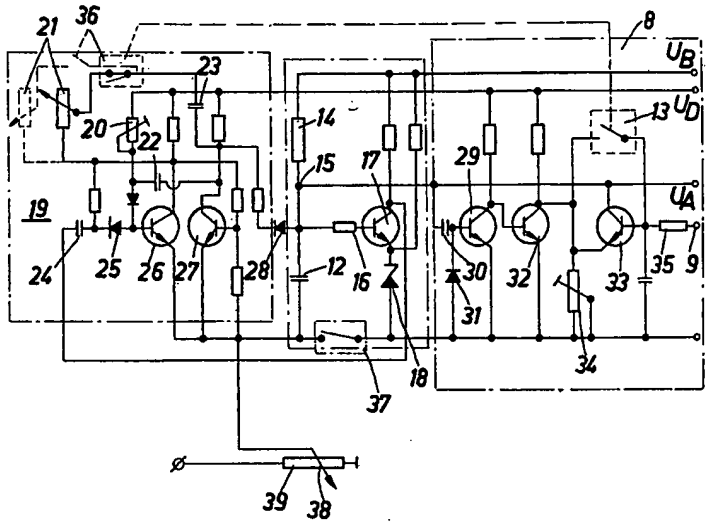


Fig. 4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U_B
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U_D
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9
U_A

Fig. 5

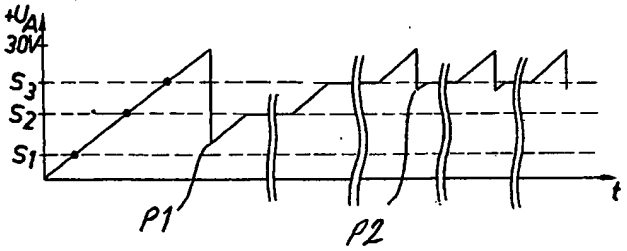
$+U_A$
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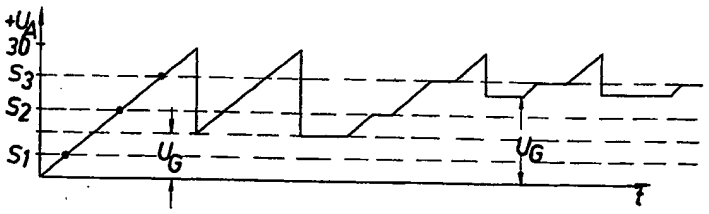
Fig. 6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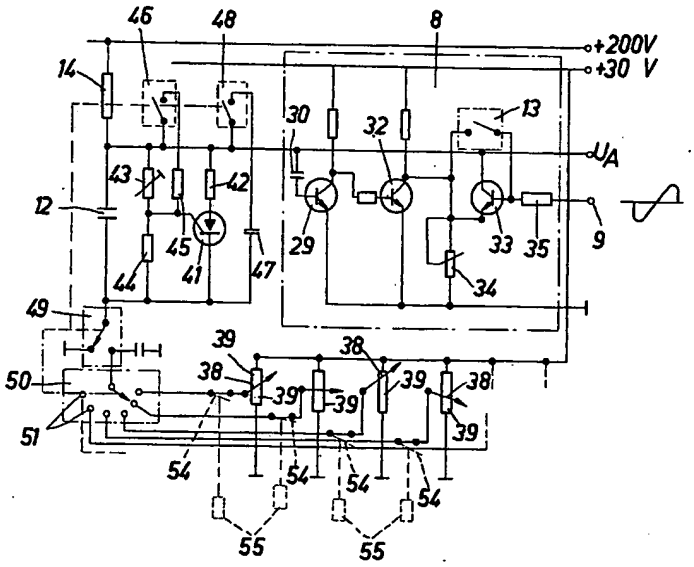
t

Fig. 7


46
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+200V
+30 V
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UA
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Fig.8

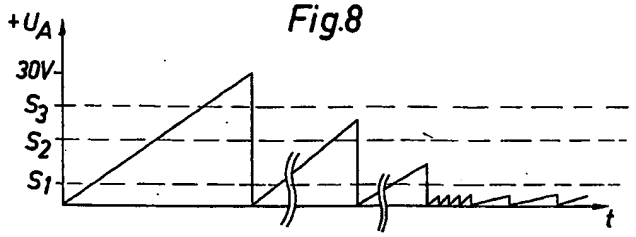


Fig.9

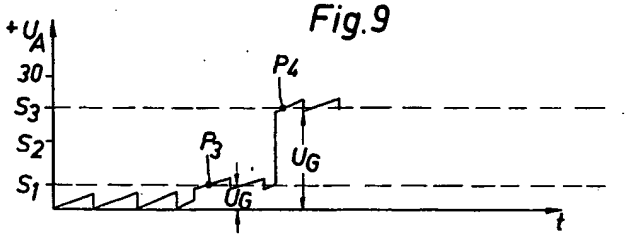


Fig.10

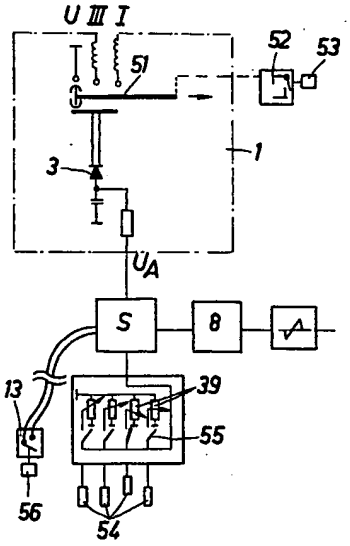
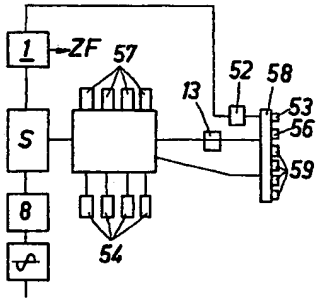


Fig.11



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Sheet 5

Fig. 12

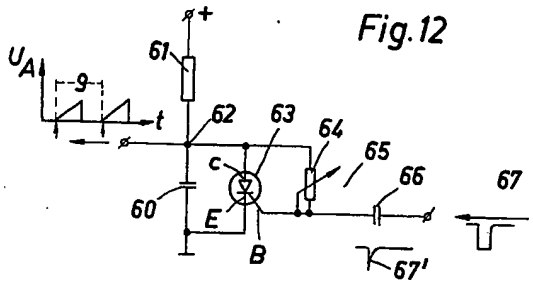

Fig. 13

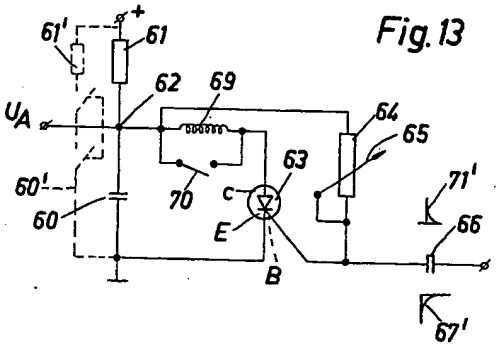

Fig. 14

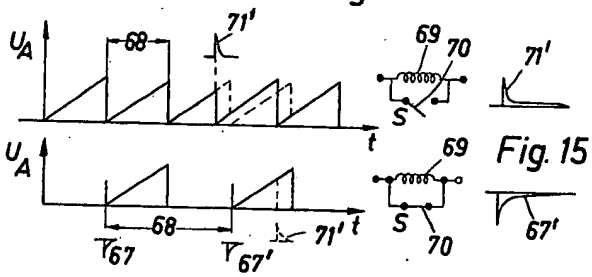

Fig. 15